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# THE ADVANCED HOUSE

# THE ADVANCED HOUSE

***ENVIRONMENTAL RESPONSIBILITY THROUGH ENERGY EFFICIENCY***

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# THE ADVANCED HOUSE

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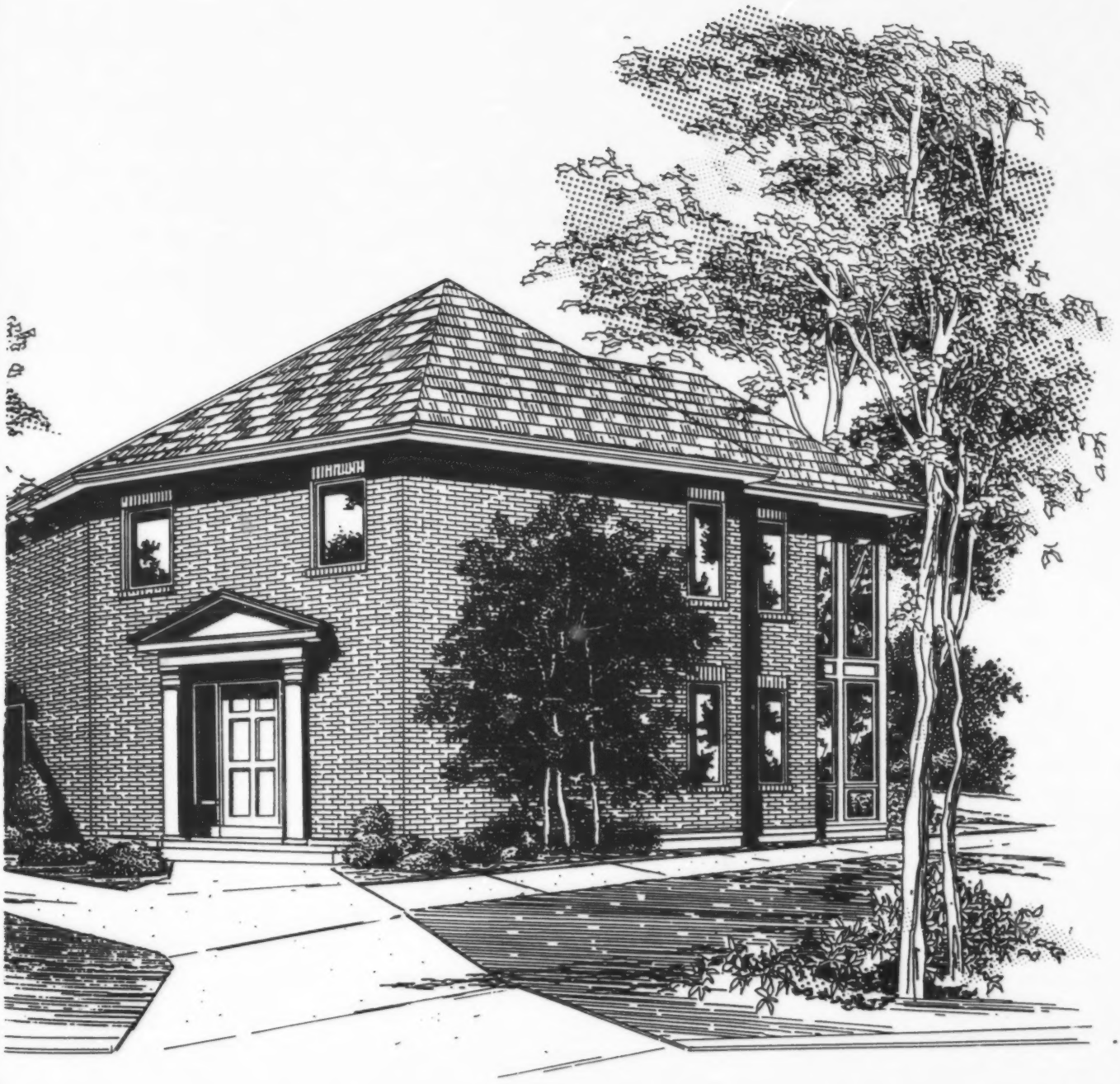
***ENVIRONMENTAL RESPONSIBILITY THROUGH ENERGY EFFICIENCY***

**Canadians are in the race against time to slow the potentially devastating environmental effects of global warming and acid rain caused by high energy consumption in the developed world.**

**Our housing, although it is more energy-efficient now than it was twenty years ago, still uses far more energy than the planet can afford.**

**The Advanced House project is a small step towards environmentally responsible housing. It demonstrates that new products and technologies, many of them developed in Canada, can dramatically reduce total home energy use without compromising comfort and safety.**

# THE ADVANCED HOUSE



***ENVIRONMENTAL RESPONSIBILITY THROUGH ENERGY EFFICIENCY***

# WHAT IS THE ADVANCED HOUSE?

The Advanced House is part of a Brampton, Ontario, subdivision. The house does not look very different from its neighbours, yet it uses just over one-quarter the energy of a conventionally built home. A series of energy-saving technologies have been integrated into the design. Some of them are so new they are not yet commercially available. Others can be purchased from the local hardware store.

The technologies are:

**HIGH-PERFORMANCE ENERGY-EFFICIENT WINDOWS.** These windows make passive solar heating a practical reality for Canada, and they are available by special order now from some manufacturers.

**INTEGRATED MECHANICAL SYSTEM.** One piece of equipment replaces the furnace, the hot water tank, the air-conditioner and the ventilation system. It uses a heat pump to recover heat from grey water, ventilation exhaust and excess passive solar gains. A thermal storage system saves the heat until it is needed. This equipment is being manufactured in limited numbers for test applications.

**ENERGY-EFFICIENT APPLIANCES.** There is no reason why our appliances have to consume as much energy as they do; the appliances demonstrated in the Advanced House are available today and use between 20% and 60% of the energy of average appliances.

**ENERGY-EFFICIENT LIGHTING.** There are no standard incandescent light bulbs in the Advanced House; the lighting is all fluorescent. The new lighting is at least as appealing and practical as incandescent lights, and uses 80% less energy.

**HIGH LEVELS OF INSULATION.** RSI 7 walls, RSI 10.6 ceilings and RSI 6.55 basement (R-40 walls, R-60 ceilings and R-37 basement) drastically reduce space heating and cooling energy use. Most of the insulation in the house is cellulose. Made from recycled newspapers, cellulose is inexpensive and environmentally friendly.

**AIRTIGHT CONSTRUCTION.** As in R-2000 construction, a continuous air barrier prevents air leakage and protects the building fabric. The house is not stuffy because fresh air flows continuously into the sun space and is circulated to each room.

**TWO-STOREY PASSIVE-SOLAR SUN SPACE.** This room is a solar collector. It collects and stores solar heat for the rest of the house and preheats the ventilation air. Occasionally, the sun space can be too hot or too cold for comfort, but most of the time it is a delightful place to be. It is not counted as living space because it has no supplementary heating or cooling systems (these would defeat its purpose).

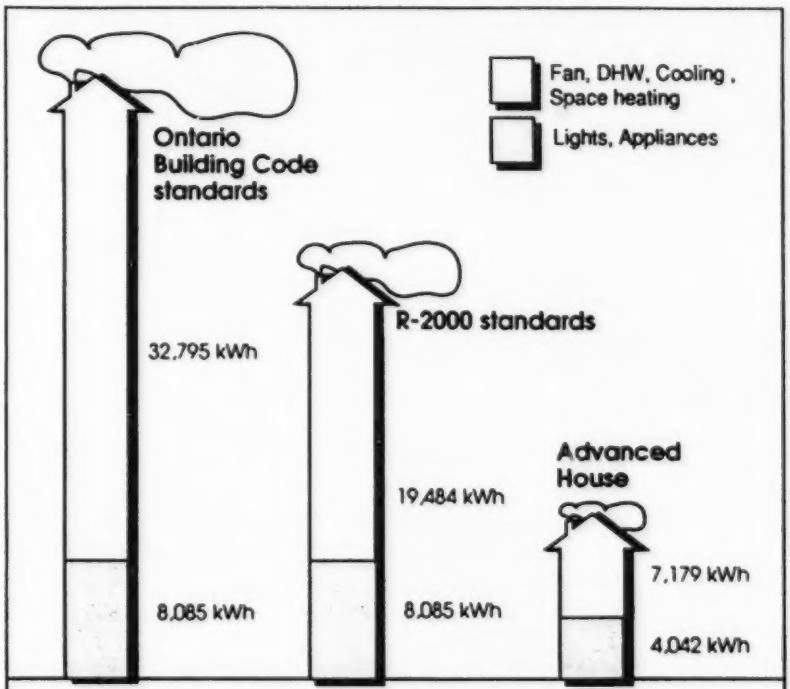
**ENERGY-EFFICIENT FIREPLACE.** Most fireplaces, even the heat-recirculating types, waste energy and contribute to air pollution. The contra-flow fireplace in the Advanced House reduces emissions by burning at high temperatures, and it stores heat in the masonry.

**ENERGY-MONITORING SYSTEM.** A two-year testing and monitoring program will verify whether the house and its components perform as predicted by the computer model.

***ENVIRONMENTAL RESPONSIBILITY THROUGH ENERGY EFFICIENCY***

## HOW MUCH ENERGY CAN BE SAVED ?

The Advanced House represents the energy-efficient housing of the future. Total energy consumption should be approximately 27% of an equivalent conventional home built to Ontario Building Code standards and 41% of an equivalent R-2000 home.

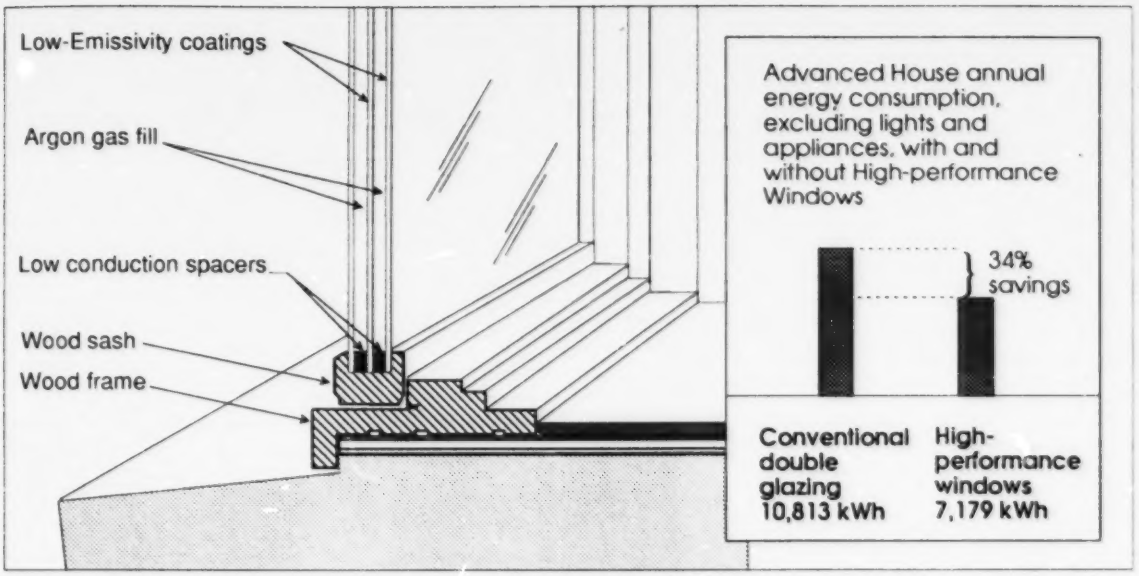



Advanced House predicted annual energy consumption, compared with a conventional house and an R-2000 house of the same design.

The performance of the house has been simulated by computer. According to predictions, the Advanced House will use 7,179 kWh of electrical energy per year for all heating and cooling, including domestic hot water. Highly energy-efficient lights and appliances are expected to consume an additional 4,042 kWh per year. At electrical rates of 7¢ per kWh, that translates to a total annual energy bill of $785, versus $1,794 for an R-2000 house or $2,862 for the same house built conventionally.

During the daily electrical peak period, power demand in the house is limited to 10 kW by a load-shedding control system, which automatically shuts off the back-up heaters when the house is using too much energy. By comparison, a standard house has a peak demand of about 20 kW.

The Advanced House is the first house of its kind in Canada and is being monitored to discover how closely it matches computer simulations, and to find out how well it performs under different conditions. Actual performance will be monitored in detail for two years. The results of the monitoring will help to make future Advanced Houses use even less energy.


Low-Emissivity coatings
Argon gas fill
Low conduction spacers
Wood sash
Wood frame
Advanced House annual energy consumption, excluding lights and appliances, with and without High-performance Windows
34% savings
Conventional double glazing 10,813 kWh
High-performance windows 7,179 kWh

## HIGH - PERFORMANCE WINDOWS

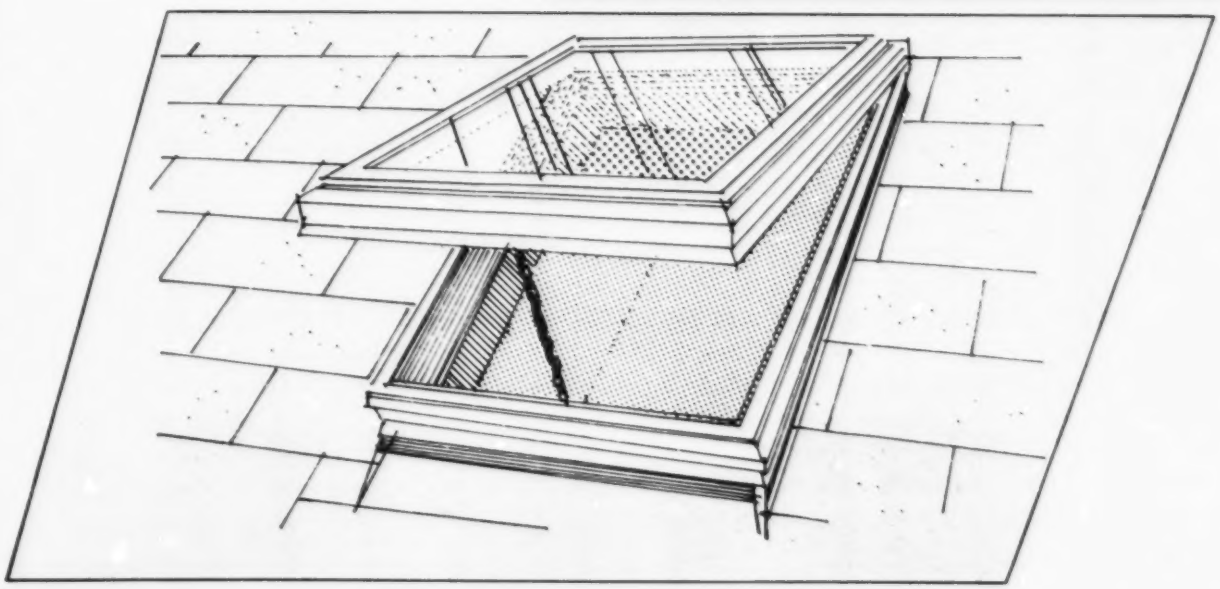
Windows are normally the largest single component of heat loss in an energy-efficient home. But new technologies can halve window energy losses. The high-performance windows used in the Advanced House have the following features:

- Triple glazing
- Two sputtered low-emissivity coatings
- Two 12 mm (1/2") airspaces
- Both airspaces argon-gas-filled
- Low-conduction spacer
- Wood frames

These windows have a whole-window RSI value of about 0.91 (R-5.2). The R-value for the glass itself is higher, RSI 1.36 (R-7.7), but heat losses at the edge of the glass and through the wood frame cause the whole-window R-values to decrease. It is important to reduce the area of the window frame, now the weak point in the house's shell, by selecting large windows with few dividers. To provide the passive solar heat, most of the window area is located on the south side of the house. There are very few windows in the north walls. The area of glass on each wall was determined using the computer model.

Skylights can provide good daylighting and help to reduce the need for artificial light, but conventional skylights lose heat in winter and tend to overheat a house in summer. The skylight over the central stairwell in the Advanced House has high-performance glazing at the ceiling level, and a conventional plastic skylight on the roof. Heat loss in winter is minimized, and overheating in summer is reduced. The skylight lights up the stairwell during the day for safety and energy savings.

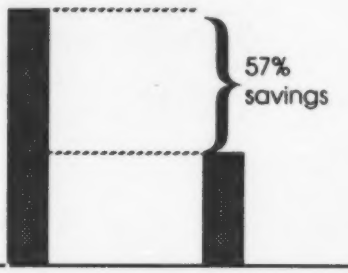
The computer model was used to compare the performance of the high-performance windows with conventional double-glazed windows. Annual energy consumption without the high-performance windows increased by 3,634 kWh, or 32% of total energy use. The passive solar contribution, which was calculated by comparing annual energy consumption with and without solar gains, was found to be 9,450 kWh, which is 84% of total energy use.



# INTEGRATED MECHANICAL SYSTEM

The integrated mechanical system (IMS) replaces all conventional mechanical systems. It consists of two units, the cabinet and the storage tank. The cabinet contains a 40-gallon hot water tank with back-up heater, a heat pump, a heating/cooling fan-coil and the exhaust-heat recovery coil. The storage tank contains water, which varies in temperature from cool to ice-cold, and a heat exchanger. The IMS is located totally indoors.

Advanced House purchased annual heating and cooling energy consumption with and without the integrated mechanical system.




**Electric furnace & air-conditioner 16,564 kWh**

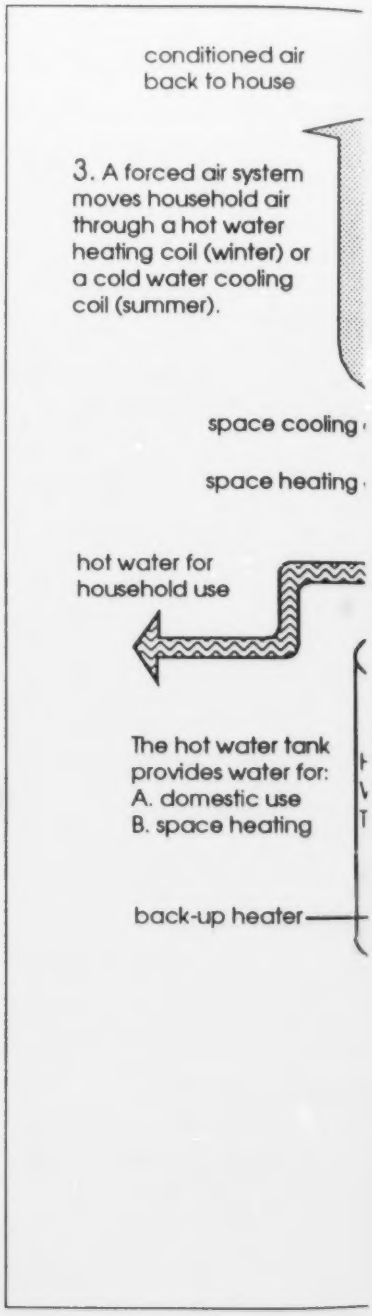
**I M S 7,179 kWh**

The IMS is run by a liquid-to-liquid heat pump, connected on the cooling side to the cold water storage tank and on the heating side to the hot water tank. Waste heat from grey water (waste water from laundry, kitchen and showers), ventilation exhaust, solar gains, internal gains and wood heat flows to the cold water storage tank, warming it up a little. When heat is needed, the heat pump operates, making the cold water storage tank cooler, and simultaneously warming the hot water tank. The energy from the cold water storage tank is free heat, so purchased energy is required only to operate the heat pump. The coefficient of performance is about 2.8.

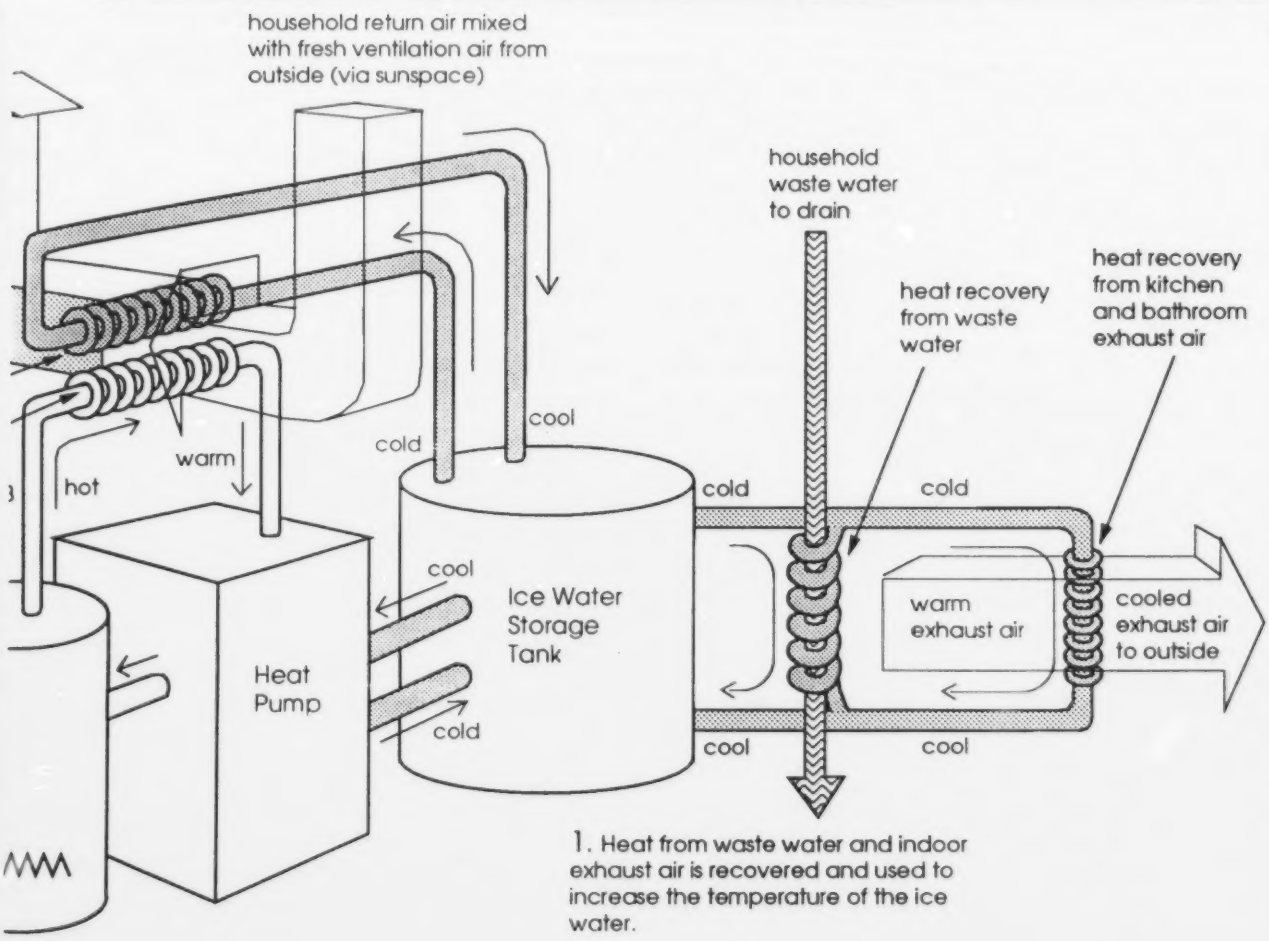
Domestic hot water is supplied directly from the hot water tank. Space heating is also supplied from the hot water tank, via the fan-coil unit. Return air from the house, mixed with fresh ventilation air from outside, is blown through the fan-coil unit and distributed to the house. When space cooling or passive solar storage is required, cold water is circulated through the cooling coil of the fan-coil unit. A separate cooling coil from the cold water storage tank provides heat recovery from the ventilation exhaust.

The grey water heat-exchange coil is mounted on one wall of the basement. A pipe carries the heat from the grey water to the cold water storage tank. Because the space heating and cooling loads are low, the heating distribution system is small and simple. Ducts are located in interior partitions, and registers are wall-mounted just below the ceiling to accommodate warm and cool air distribution.

When the Advanced House design was simulated with an electric furnace and a central air-conditioner, instead of an integrated mechanical system, the purchased annual energy consumption (excluding lights and appliances) more than doubled, rising from 7,179 kWh to 16,564 kWh. Why is the IMS so efficient? The thermal storage, the heat pump and the heat recovery permit greater efficiencies and better use of passive solar heat. The equipment has been tested by Ontario Hydro and is being manufactured in limited numbers for trial applications.


conditioned air
back to house
3. A forced air system moves household air through a hot water heating coil (winter) or a cold water cooling coil (summer).
space cooling
space heating
hot water for household use
The hot water tank provides water for:
A. domestic use
B. space heating
back-up heater

# INTEGRATED MECHANICAL SYSTEM SCHEMATIC




1. Heat from waste water and indoor exhaust air is recovered and used to increase the temperature of the ice water.

2. When space heat is required the heat pump extracts energy from the ice water tank (making it even colder) and uses this to warm the water in the hot water tank.

***ENVIRONMENTAL RESPONSIBILITY THROUGH ENERGY EFFICIENCY***

# ENERGY - EFFICIENT APPLIANCES

There is no reason why our appliances should use as much energy as they do; the appliances demonstrated in the Advanced House are available today and use between 20% and 60% of the energy of average appliances.

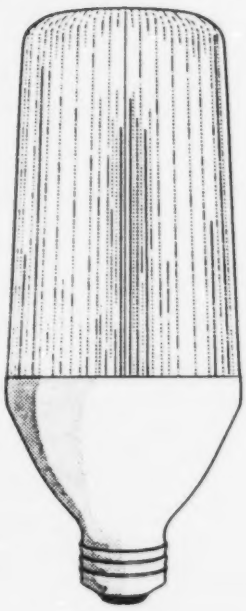
The refrigerator in the Advanced House is so efficient it can be powered by photovoltaic solar panels. It is probably the most energy-efficient refrigerator in the world; it uses about 20% of the energy of a conventional refrigerator. If this type of refrigerator were mass-produced, it would cost little more than a conventional refrigerator.

The other kitchen and laundry appliances are made in Europe. European appliances are generally more efficient than North American ones, and use less water. The cooktop includes two halogen elements. They are more efficient than other elements and are safer too, because the heat stays where it is needed, under the cooking pot. The dishwasher is one of the most efficient on the market and is also water-saving. There are two ovens in the Advanced House kitchen. One is a microwave, which is the most energy-efficient way to cook, unless it is used to thaw frozen foods, in which case it uses more energy. The other oven is a well-insulated combination conventional and convection oven. The convection oven is more efficient because it cooks faster.

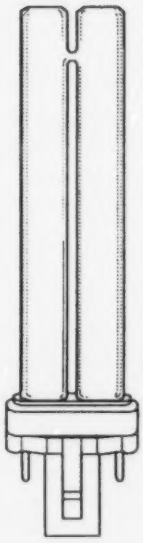
Front-loading European style clothes washers are usually about 35% more efficient than top-loading types, and save water too. This washer heats its own water to whatever temperature is set; the lower the temperature, the more energy is saved. The clothes dryer is a little more efficient than most. New heat-pump and microwave dryers should be available in the mid-1990s. These new technologies will save 50% or more of our clothes-drying energy. Outside in the Advanced House garden is the solar dryer, the most energy-efficient clothes dryer yet invented, otherwise known as the clothes line!

# ENERGY - EFFICIENT LIGHTING

Natural daylight is, of course, the best and most energy-efficient form of lighting. Artificial lighting in the Advanced House is provided entirely by energy-efficient fluorescent lamps (compact and standard lamps), and by some halogen lamps. There are no standard incandescent light bulbs. The fluorescent lighting saves 80% of the energy used by incandescent lights. Halogen lamps are much less efficient than fluorescent; the savings are about 30%. The Advanced House demonstrates that fluorescent lighting can be used to create exciting interiors; the interior designers have used fluorescents for cornice lighting, recessed lighting, uplights, and task lighting, and for several special wall sconces and table lamps. Halogen lamps are used only where an intense beam of focused light is needed. The energy-efficient lighting is expected to save about 800 to 1,000 kWh per year, or about the same amount of energy that the high-efficiency refrigerator will save.



COMPACT FLUORESCENT LAMP WITH PRISMATIC LENS



TWIN-TUBE COMPACT FLUORESCENT LAMP

Outside the advanced house are some landscaping lights which require no purchased energy at all! They are powered by photovoltaic panels, which convert sunlight to electricity. Photovoltaic, or pv, cells are already in use in areas not served by the utility grid. Small pv cells power many pocket calculators.

***ENVIRONMENTAL RESPONSIBILITY THROUGH ENERGY EFFICIENCY***

# HIGH LEVELS OF INSULATION

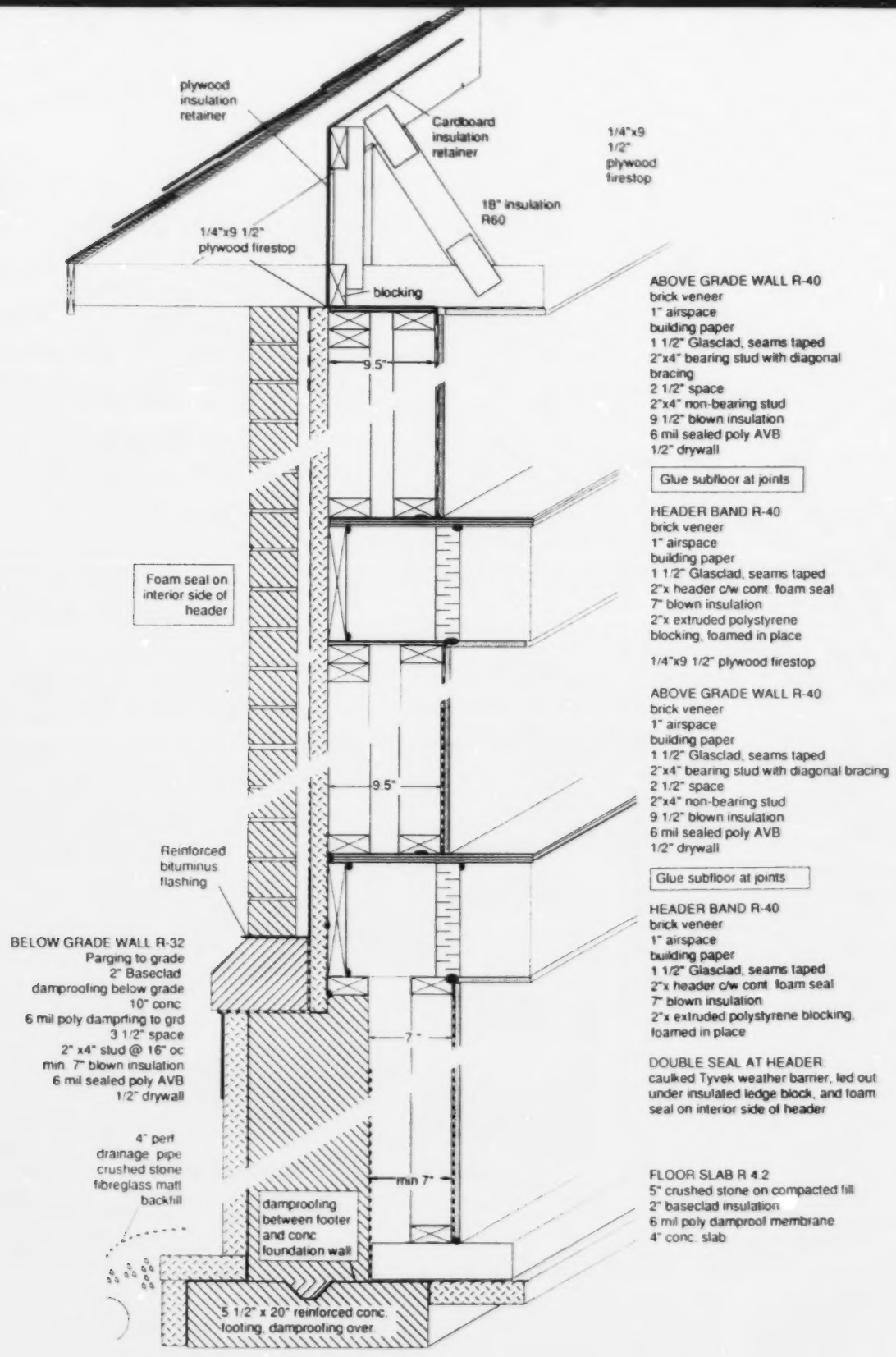
High levels of insulation, more than double those found in a conventional Toronto-area home, drastically reduce Advanced House space heating and cooling energy use.

| | | | |
|---|---|---|---|
| Ceilings | RSI | 10.6 | (R-60) |
| Above-grade walls | RSI | 7.0 | (R-40) |
| Below-grade walls | RSI | 6.55 | (R-37) |
| Basement floor slab | RSI | 1.2 | (R- 7) |

Cellulose was used for insulation wherever possible. Cellulose insulation, made from recycled newspapers, is inexpensive and environmentally friendly. Dry-blown cellulose was used in the ceilings. The insulation levels are highest in the ceilings because there is lots of space for insulation in the roof cavity.

The above-grade walls are double-framed. The house was framed conventionally out of 38 mm x 89 mm (2" x 4") lumber. Then a second 38 mm x 89 mm (2" x 4") lumber-framed wall was erected on the inside, spaced away from the outer wall to create a 241 mm (9 1/2") deep cavity. This cavity was filled with wet-blown cellulose insulation. The wet-blown cellulose fills all the spaces in the wall cavity, reducing convection loses within the wall. Glass fibre insulating sheathing provides further insulation above grade and lets the wall breathe, allowing the wet-blown cellulose to dry.

The basement is insulated both on the outside and on the inside. On the outside, a layer of glass fibre material specially designed for below-grade use provides some insulation and keeps the foundation dry. The bulk of the insulation is on the inside. Dry-blown cellulose was blown into a closed wall cavity, created by framing a wall on the inside of the concrete foundation. The under-side of the basement floor slab was insulated with semirigid glass fibre for comfort considerations.




***ENVIRONMENTAL RESPONSIBILITY THROUGH ENERGY EFFICIENCY***

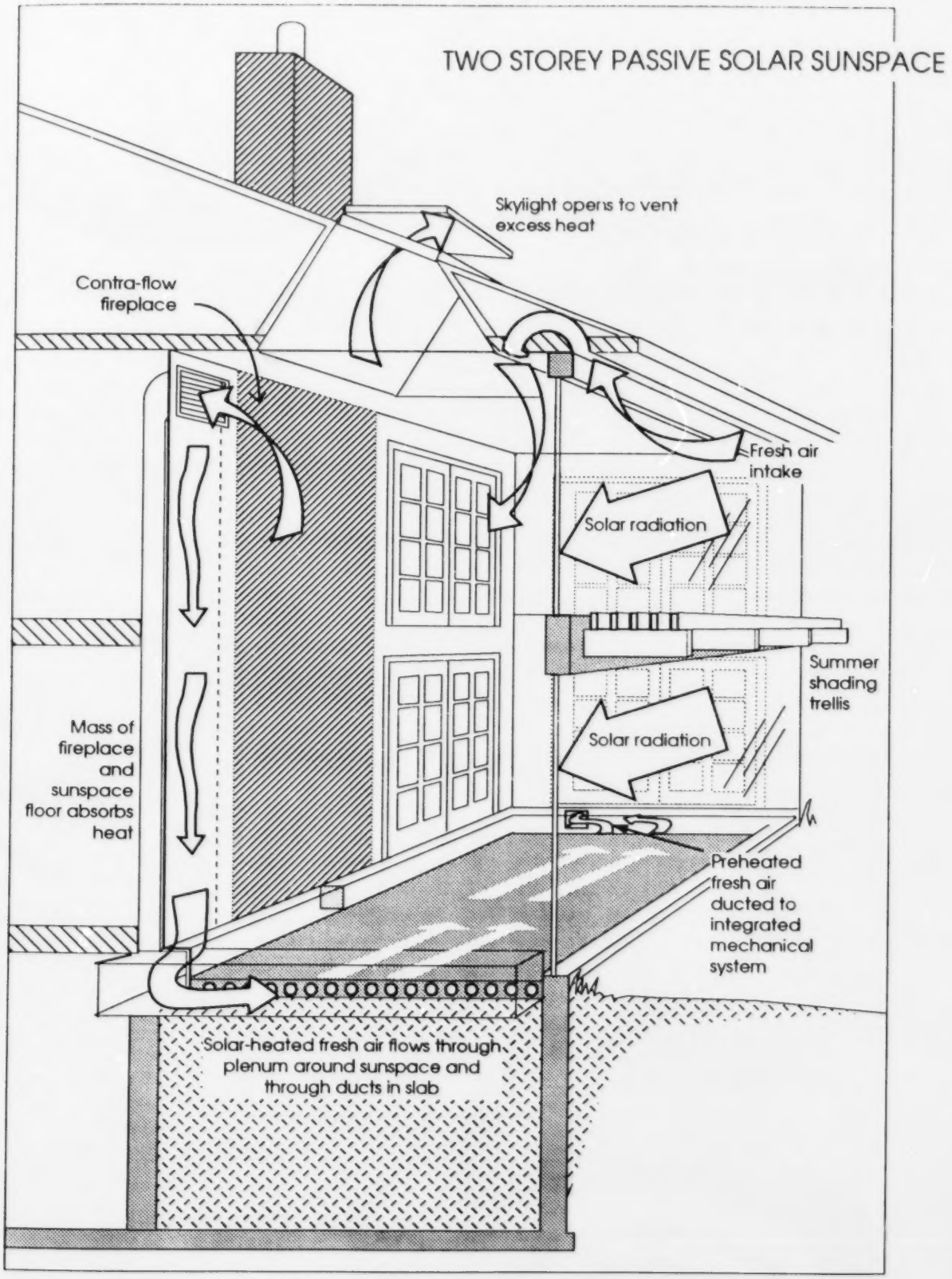
## AIRTIGHT CONSTRUCTION

As in R-2000 construction, a continuous air barrier prevents air leakage and protects the building fabric. The house is not stuffy because fresh air flows continuously into the sun space and is circulated to each room.

The Advanced House has a measured airtightness of under 1 airchange per hour at 50 pascals (an R-2000 must achieve an airtightness of 1.5 airchanges per hour at 50 pascals). The primary air barrier is 6 mil sealed polyethylene, installed directly behind the drywall. The exterior weather barrier and the interior drywall provide secondary air barriers. Difficult-to-seal details such as overhangs, cantilevers and living space over unheated areas were eliminated from the design. Plywood boxes, sealed to the window frames before installation, make an airtight seal with the polyethylene air barrier and eliminate air leakage around the windows. Electrical boxes are moulded thermoplastic with gasketed cover plates. Vents and other penetrations are carefully sealed.

## TWO - STOREY PASSIVE - SOLAR SUN SPACE

The sun space opens off the family room and the breakfast area on the south side of the house. The room is a solar collector. It collects and stores solar heat for the rest of the house and preheats the ventilation air. Occasionally, the sun space can be too hot or too cold for comfort, but most of the time it is a delightful place to be.


TWO STOREY PASSIVE SOLAR SUNSPACE
Skylight opens to vent excess heat
Contra-flow fireplace
Fresh air intake
Solar radiation
Summer shading trellis
Solar radiation
Mass of fireplace and sunspace floor absorbs heat
Preheated fresh air ducted to integrated mechanical system
Solar-heated fresh air flows through plenum around sunspace and through ducts in slab

The majority of the house's south glass area is located in the sun space. Passive gains are stored in the concrete floor slab, in the backfill under the slab, and in the masonry fireplace. The heat is transferred to the heated living space through the common walls, and through the uninsulated glass doors which connect the two spaces.

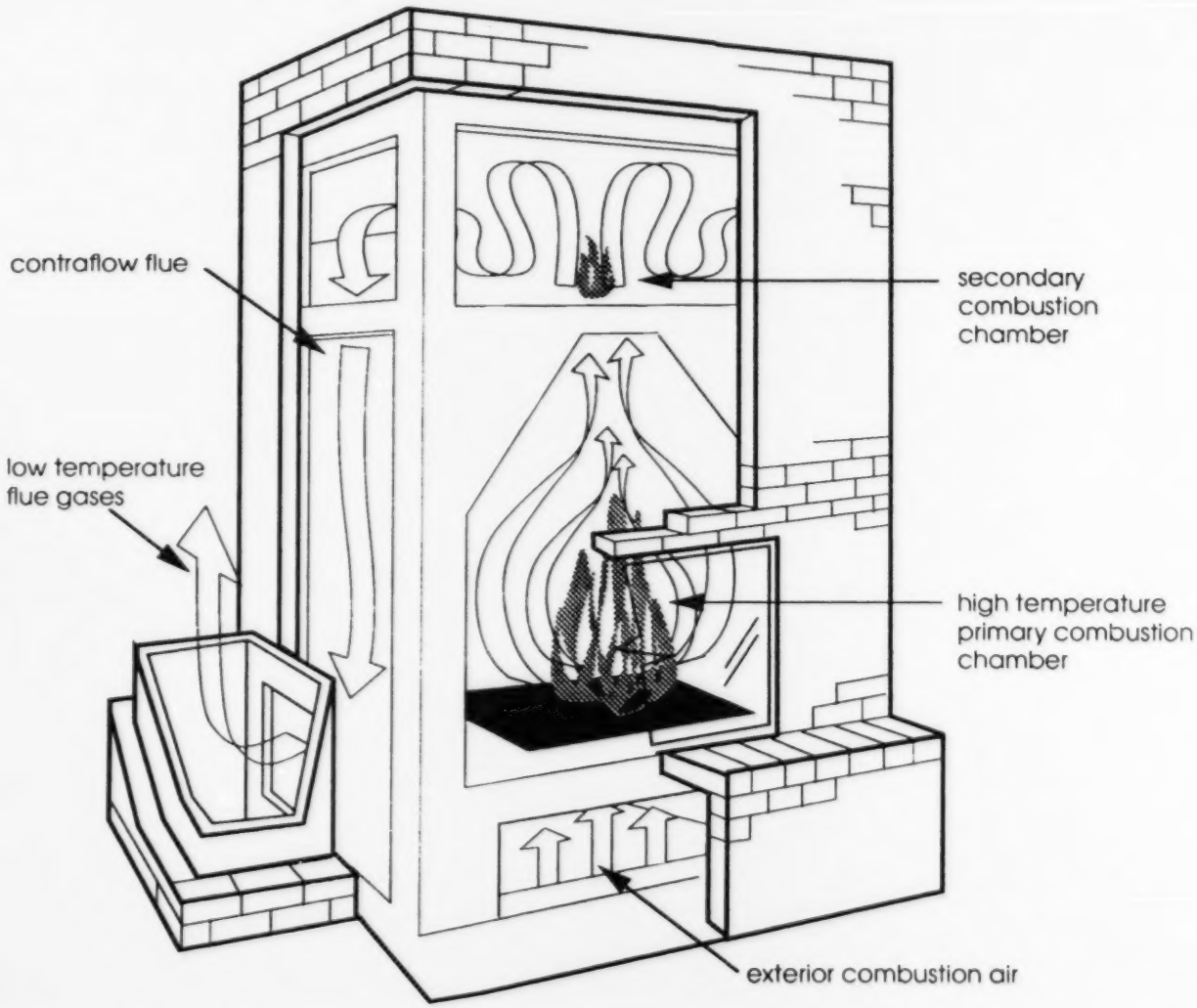
The sun space provides passive preheating of fresh ventilation air. Outdoor air is ducted to the ceiling of the sun space. A high air return duct pulls the fresh, warmed air off the ceiling down to the floor slab, where it is circulated through a series of parallel-flow ducts. The fresh air then flows to the integrated mechanical system for additional heating, if necessary, before distribution to each room.

An automatically operated roof window with high-performance glazing provides passive cooling when the sun space gets too hot. There is no forced ventilation. Reflective window blinds inside and the shading trellis outside provide summer shading.

## ENERGY - EFFICIENT FIREPLACE

A conventional fireplace contributes little, if anything, to space heating and produces toxic emissions through low-temperature and incomplete combustion. Glass doors and heat-recirculating fans provide modest efficiency improvements. The fireplace demonstrated in the Advanced House has much higher efficiencies. The fireplace is a prefabricated, contra-flow masonry unit with exterior combustion air and glass doors. The principle is similar to the Scandinavian contra-flow masonry heaters. A fast, hot burn reduces toxic emissions and heats up the masonry, which in turn gradually radiates its heat to the room. The fireplace is located on an interior wall between the family room and the sun space. The mass absorbs passive solar heat from the sun space and can also be used to radiate wood heat to the sun space when solar heat is not available. The unit can also be supplied with a bake oven, providing further energy savings for cooks!

# HIGH-EFFICIENCY CONTRAFLOW FIREPLACE




***ENVIRONMENTAL RESPONSIBILITY THROUGH ENERGY EFFICIENCY***

## COMPONENT TESTING

Many of the components that make up the Advanced House have been individually tested for thermal performance and energy efficiency. This is in addition to the monitoring in the house itself. The testing is important because it verifies some of the data input for the computer model and because it will help the interpretation of the monitoring data. The high-performance windows have undergone whole-window thermal testing. The integrated mechanical system has been bench-tested at an Ontario Hydro testing laboratory. The fireplace has passed emissions testing by the U.S. Environmental Protection Agency, and efficiency testing at a federal combustion research laboratory. Samples of the wet-blown cellulose insulation are being tested to ASTM C518, and a sample wall panel is undergoing guarded hot-box testing to ASTM C236.

## COMPUTERIZED ENERGY - MANAGEMENT AND MONITORING SYSTEM

Two personal computers located in the basement collect monitoring data and control some of the energy use in the house. One computer switches off the back-up electric heater in the hot water tank during peak periods, when the generating stations are overloaded. It also controls the motorized roof window in the sun space, and switches the integrated mechanical system from "winter" to "summer" mode (which happens frequently during spring and fall). The computer also controls security lighting circuits.

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Because purchased energy use is so low in this building, and because of the built-in thermal storage capacity of the integrated mechanical system, peak loads are low. By restricting the use of the back-up coils, instantaneous demand can probably be kept under 10 kW during the peak period, compared to 20 kW for a conventional house.

Monitoring data collected in the second basement computer will be fed into another computer for analysis. The analysis will indicate how much total purchased energy is required under different weather conditions, how well the integrated mechanical system works, what the effects are of operating the various appliances and lights, how closely the actual energy use matches the computer model, and what the effectiveness and drying rate are of the wet-blown insulation.

## SUSTAINABLE FUTURE IDEAS

A house's energy consumption is probably the biggest factor in determining whether the home is environmentally sustainable, but it is not the only factor. Other issues include the energy content of the materials that go into the house, their toxicity and the environmental effects of their manufacture and eventual decay. The way we use our homes is another big factor. Recycling, composting, water conservation, reduced automobile use, and the elimination of toxic products in and around the home are examples of positive lifestyle changes individuals can make. While the Advanced House is primarily about energy efficiency, these other interrelated aspects of environmentally responsible housing are also demonstrated in the house.

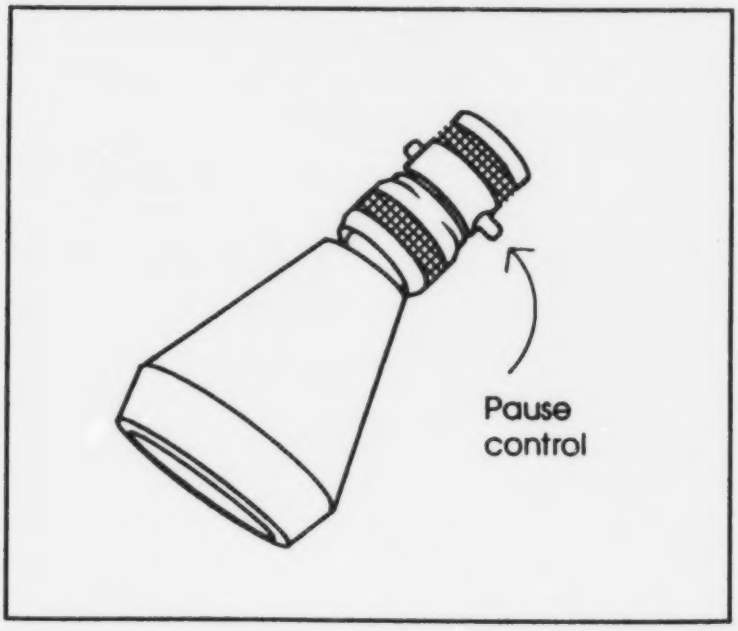
***ENVIRONMENTAL RESPONSIBILITY THROUGH ENERGY EFFICIENCY***

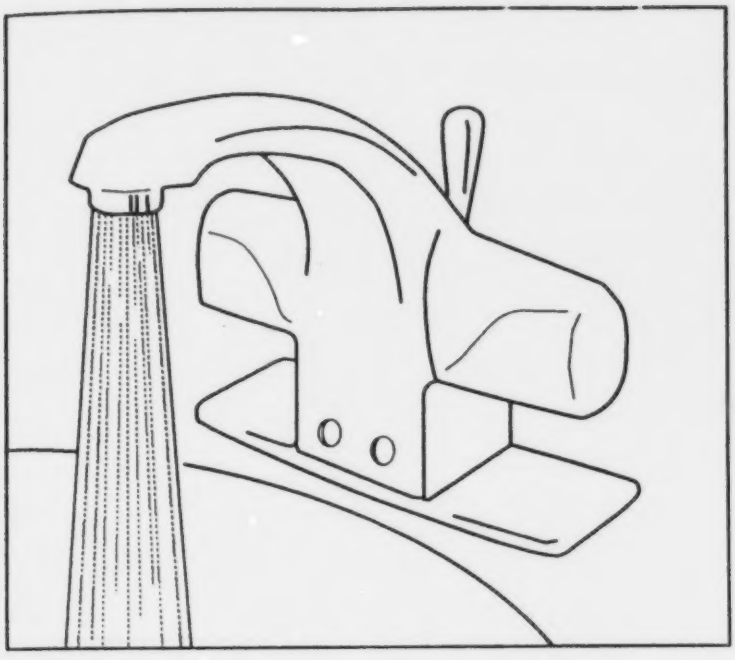
## WATER - SAVING EQUIPMENT

The toilets in the Advanced House use 5 litres (just over 1 imperial gallon) per flush. Conventional toilets use between 14 and 23 litres (3 to 5 gallons), and water-saving toilets use 9 litres (2 gallons). When water comes from underground aquifers, it is essential to conserve it, and even lake water should not be used extravagantly. The less water we use, the less we have to treat. Water conservation makes economic sense and it is better for the environment.

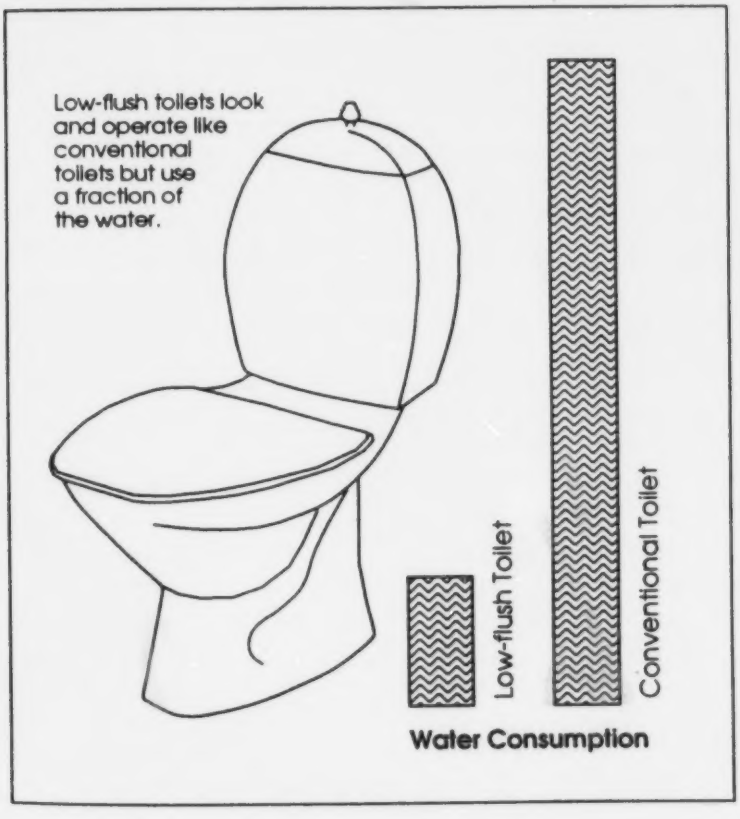
Water-saving showerheads and faucets can cut the amount of hot water used for showers and hand washing by up to 70%. The tap in the main floor powder room has an automatic sensor to turn it on and off. This tap not only saves water, and the energy required to heat it, but is very helpful for people with disabilities like arthritis, who have trouble using a conventional tap.

LOW-FLOW SHOWERHEAD





LOW-FLOW
FAUCET


Low-flush toilets look and operate like conventional toilets but use a fraction of the water.
Low-flush Toilet
Conventional Toilet
Water Consumption

TYPICAL
LOW-FLUSH TOILET

***ENVIRONMENTAL RESPONSIBILITY THROUGH ENERGY EFFICIENCY***

## ENERGY SAVINGS FROM WORKING AT HOME

The home office, located in an upstairs bedroom, is a practical alternative to daily commuting.

Telecommunications and portable computers now make it possible for many people to work at home, at least part of the time. Next to the energy we use at home, private transportation accounts for our biggest energy use. Every automobile trip avoided is a plus for the environment.

## THE COLD CELLAR

The cold cellar is located under the front porch and is vented to the outside. It provides year-round cool temperatures for storing fruits and vegetables, and wine for those so inclined! Not only does the cold cellar provide free cooling, it also frees up valuable refrigerator space. A cold cellar permits economical bulk buying, perhaps direct from an organic farm (more energy savings, plus reduced soil erosion) and can reduce shopping trips, saving on gasoline.

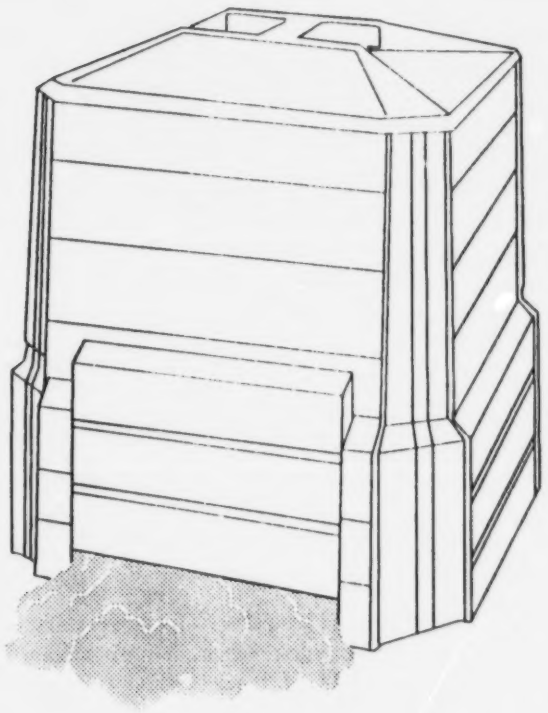
## "CLEAN" INDOOR ENVIRONMENT

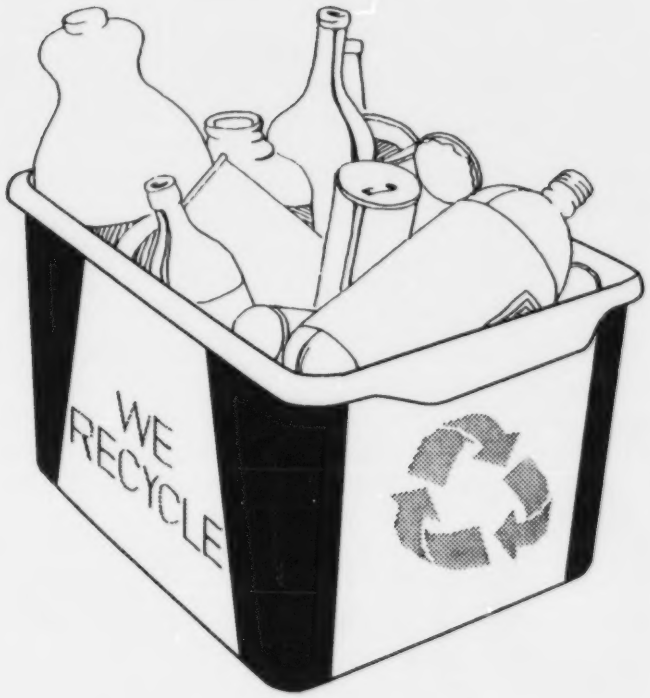
The Advanced House was not designed for the environmentally sensitive (people who are unable to function at home or in the workplace because they are physically sensitive to various substances in their indoor environment), but it does demonstrate some of the features of the new breed of "clean" buildings designed for the environmentally sensitive. These are buildings which combine low toxicity, easy-to-clean interior finishes with well-insulated, airtight construction techniques and specially designed energy-efficient ventilation systems. "Clean" buildings enable environmentally sensitive people to function more normally, but they have other benefits too.

A general move towards "clean" buildings would help to reduce the fossil-fuel content of our building interiors and the toxic burden on the environment. "Clean" building features of the Advanced House include the well-insulated, airtight construction and central heat-recovery ventilation system, which supplies fresh air to each room. The Advanced House also demonstrates the use of low-toxicity paints. And, wherever possible, natural and native materials have been used for furnishings and finishes.

## COMPOSTING AND RECYCLING

The blue box in the kitchen and the compost bin outside not only reduce the need for landfill sites, but contribute energy to our society. For example, recycling an aluminum can saves 95% of the energy needed to make a new one, and recycling plastic into new products uses 88% less energy than making plastic from new materials. Compost, the basis of organic gardening, replaces the need for synthetic fertilizers; it takes 38,000 cubic feet of natural gas to make one ton of anhydrous ammonia used for nitrogen fertilizers.






## ECOLOGICAL LANDSCAPING

Water conservation and the elimination of synthetic inputs, such as toxic pesticides and fertilizers, which require large quantities of energy for their manufacture, were the objectives for the Advanced House landscaping. The area is small and the plan simple. The plantings are hardy native trees and shrubs. The compost bin provides the fertilizer for this organic garden. It improves soil structure and the ability of the soil to hold plant nutrients, and can reduce soil erosion.

An underground irrigation system keeps the lawn green but uses a fraction of the water of a sprinkler system because evaporative losses are eliminated. By tying the irrigation system to the integrated mechanical system, the cooling capacity of the IMS is increased. In other words, watering the lawn in summer keeps the house cool!

## COSTS

The extra costs of building Advance House features into a new home are recovered over time through energy savings, and through added amenities such as the sun space. Feature by feature, the extra costs break down as follows:

### HIGH-PERFORMANCE WINDOWS

These windows cost about 30% more than conventional windows. The simple payback is 3 to 6 years. Costs are dropping as the technology becomes more widespread.

### INTEGRATED MECHANICAL SYSTEM

This unit costs about the same as the combined cost of the equipment it replaces, that is, the furnace, hot water tank, air-conditioner and heat-recovery ventilator.

### ENERGY-EFFICIENT APPLIANCES

The imported appliances in the Advanced House cost more than twice the price of standard appliances. These costs should be recovered in energy savings over the lifetime of the appliance.

### ENERGY-EFFICIENT LIGHTING

A compact fluorescent lamp can cost 16 times as much as a regular light bulb, but it lasts much longer and more than pays for itself in energy savings.

### HIGH LEVELS OF INSULATION

There is about twice as much insulation in the Advanced House as in a conventional house, so insulation prices are double. However, insulation is inexpensive, especially when it is made out of recycled materials. Extra wall framing is also involved. This can add between 15% and 25% to the cost of framing a house.

### AIRTIGHT CONSTRUCTION

Making sure that the building is properly airsealed is not a big job if the house is well-designed and properly framed. Airsealing can add up to 1% to the cost of a new home.

**TWO-STOREY PASSIVE-SOLAR SUN SPACE**
This feature is expensive, about $100 or more per square foot, and it is hard to say how much of the cost should be attributed to the energy features of the house and how much is an added amenity that a homeowner would want anyway.

**ENERGY-EFFICIENT FIREPLACE**
The precast contra-flow unit costs between 2 and 3 times as much as a conventional fireplace. Payback depends on how much the fireplace is used and the cost of firewood.

Although these costs may seem high to a prospective homebuyer, Advanced House technologies represent an inexpensive way for a utility company to supply new power! Because the Advanced House has a peak load of 10 kW, compared to 20 kW for a conventional house, it in effect supplies the power company with 10 kW. Many utility companies recognize the economics of energy conservation, energy efficiency and renewable energy, and are increasing their energy-efficiency incentives to builders and homeowners. Energy efficiency is much less expensive than building new power-generating stations, particularly if all the environmental costs are included.

## SUMMARY

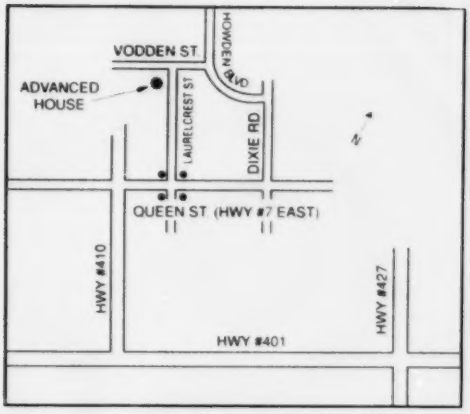
The Advanced House is predicted to consume under 12,000 kWh a year for all energy uses. An R-2000 house of the same design would require 28,000 kWh a year, and a house built to the Ontario Building Code would use 41,000 kWh a year. Two years of detailed monitoring will confirm whether or not the house is meeting the energy target, and will identify any problems such as summer overheating and delays in the integrated mechanical system response time.

The ideas demonstrated in the Advanced House are important. Energy savings translate into reduced greenhouse gas emissions and reduced pollution.

***ENVIRONMENTAL RESPONSIBILITY THROUGH ENERGY EFFICIENCY***

# VISIT THE ADVANCED HOUSE

The Advanced House is located in Brampton, Ontario and is open for public and industry tours for 12 months from February 26, 1990. Opening hours are from 12:00 noon - 6:00 p.m., Wednesday, Thursday and Friday, and from 10:00 a.m. - 4:00 p.m. Saturday and Sunday. For tour groups, please telephone (416) 450-6713.




## HOW TO GET THERE

The house is at the southeast corner of Vodden and Laurelcrest streets in Brampton, one block north of Highway 7, west of Dixie.

**BY PUBLIC TRANSIT:**
Travel by Go Transit to the City Centre, Bramalea. Take the Number 17 Howden bus to the corner of Vodden and Howden. Walk south on Vodden two short blocks (less than 5 minutes). The Advanced House is on the left hand side at Laurelcrest. Number 17 buses run every half hour.

**BY CAR:**
Take Highway 401 to exit 346, Dixie Road, (west of the Toronto International Airport, east of Highway 10). Drive north on Dixie to the Highway 7 and Dixie intersection. Go one block north of Highway 7 on Dixie and turn left onto Howden at the first set of lights. Drive west 1 km on Howden and turn left onto Vodden. The Advanced House is on the left, two blocks down.

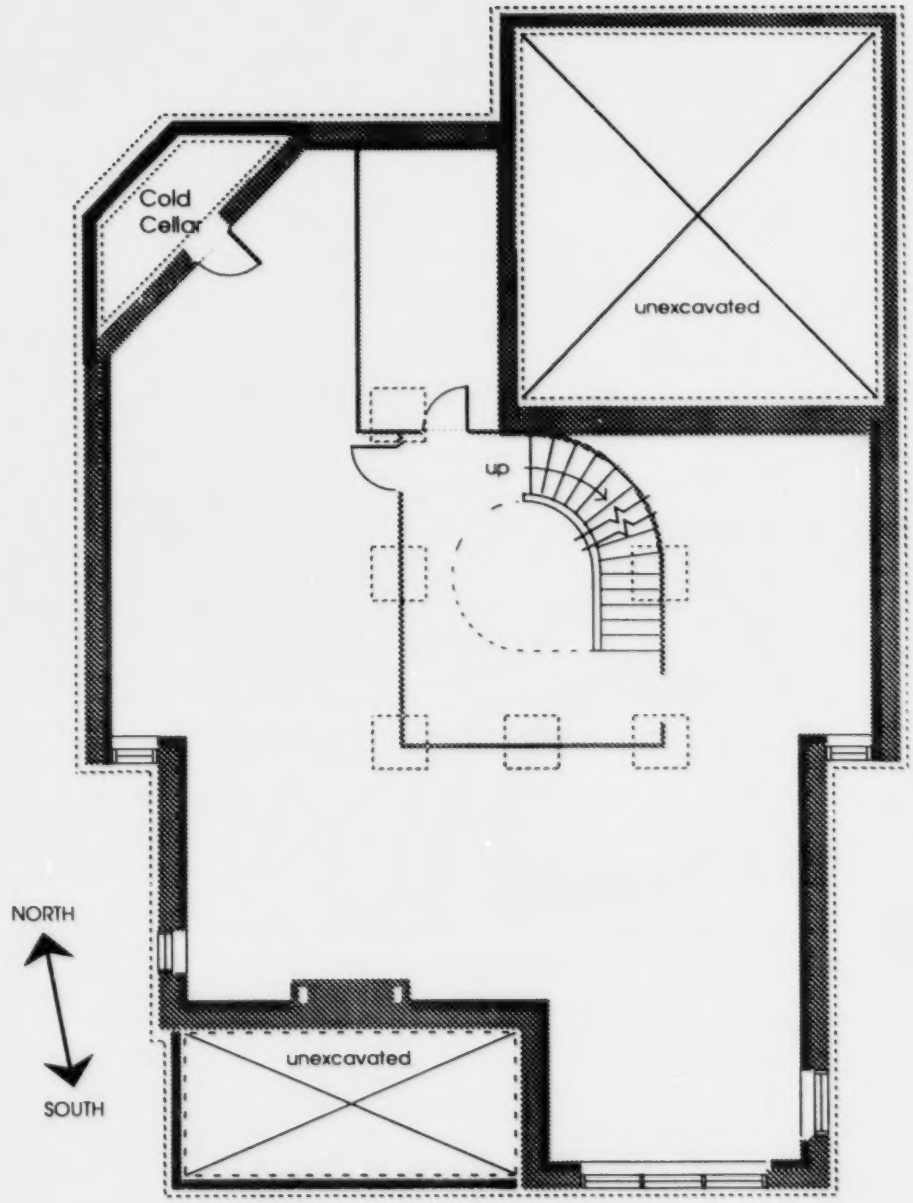
# CONTACTS

ENERGY, MINES & RESOURCES, CANADA,
580 Booth Street, Rm 727, Ottawa, Ontario
K1A 0E4, (613) 996-8136

ONTARIO MINISTRY OF ENERGY
56 Wellesley Street West, Toronto, Ontario
M7A 2B7, (416) 965-3246 or call Operator & ask for Zenith 80420

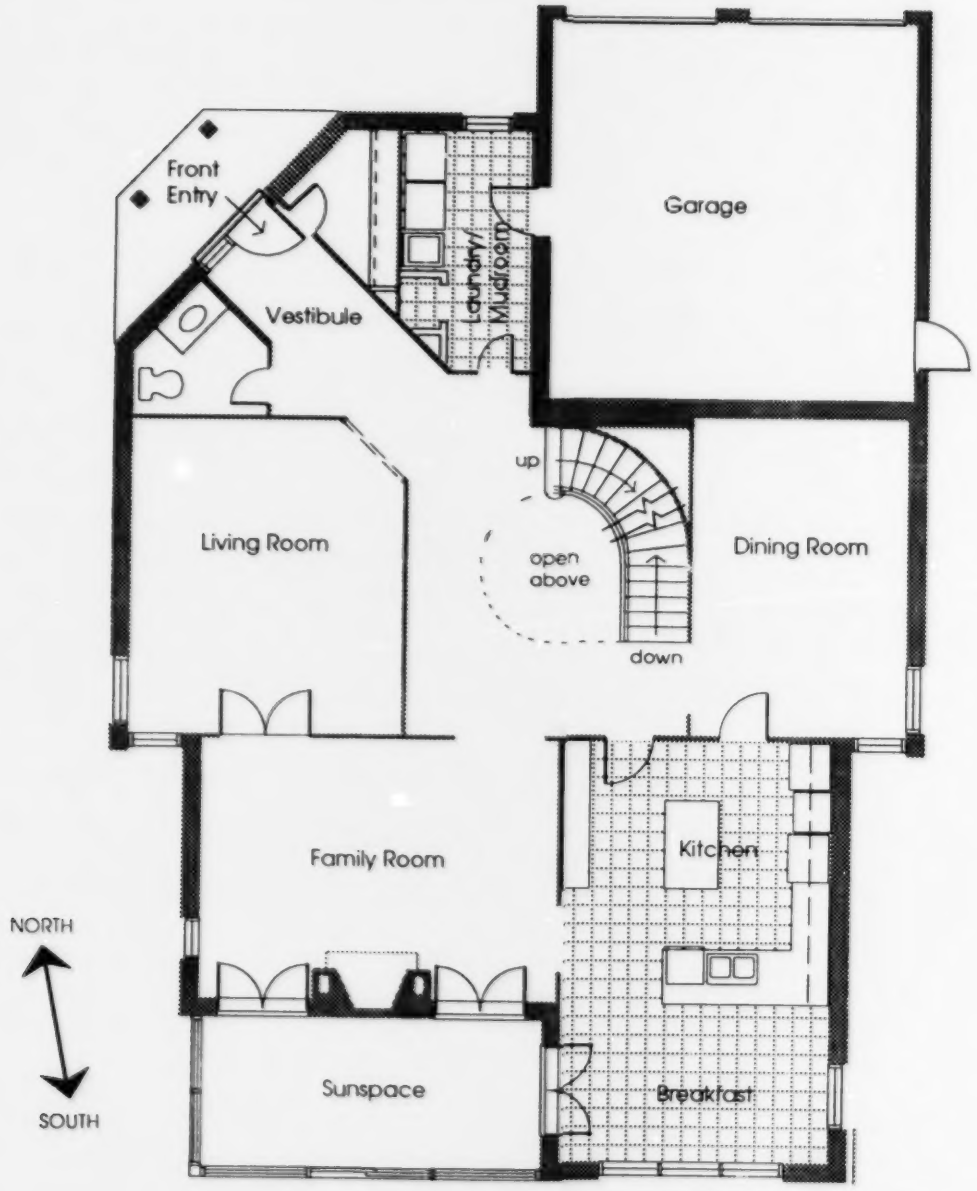
ONTARIO HYDRO,
Program Support & Service Division,
700 University Avenue C25, Toronto, Ontario
M5G 1X6, (416) 592-3780

# BASEMENT FLOOR PLAN

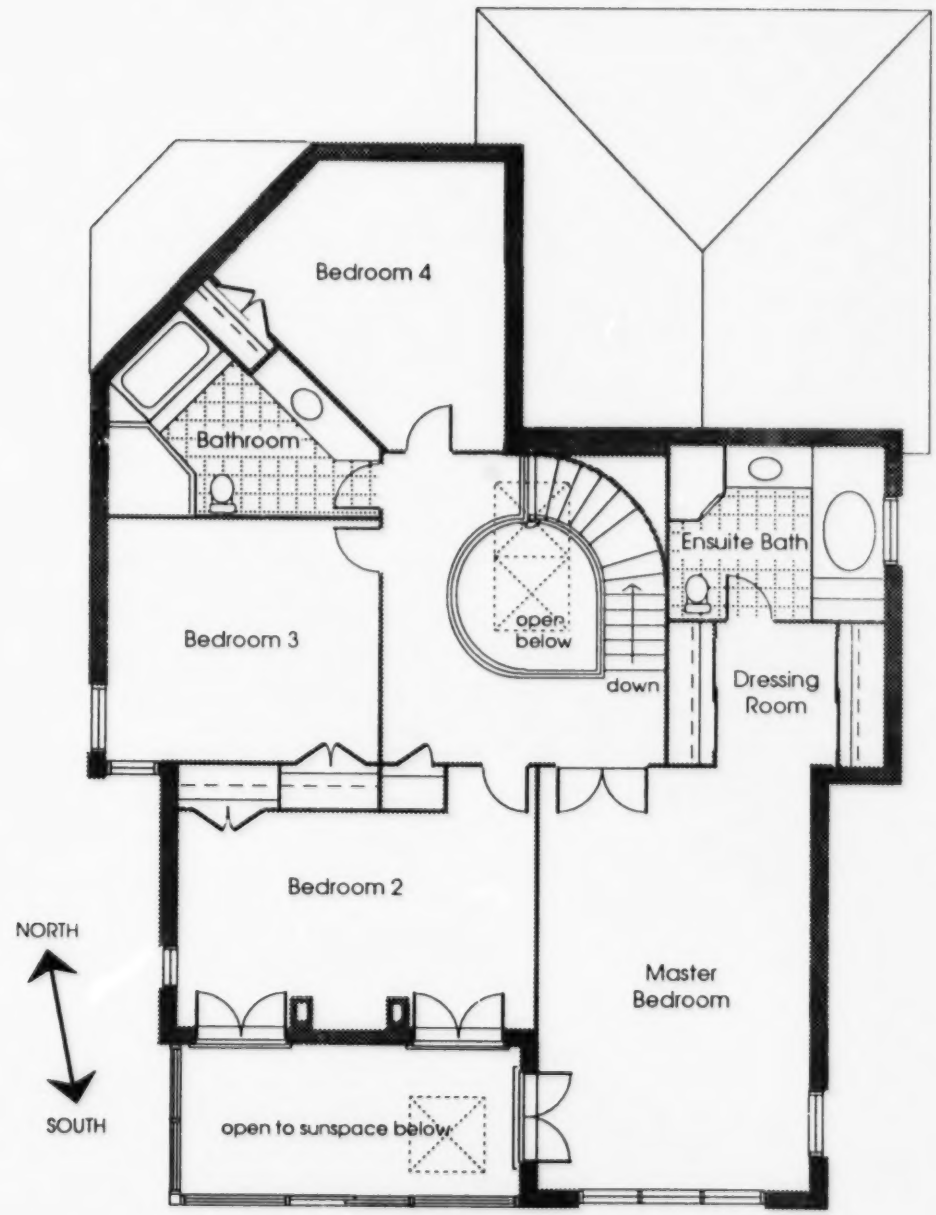



***ENVIRONMENTAL RESPONSIBILITY THROUGH ENERGY EFFICIENCY***

# GROUND FLOOR PLAN



# SECOND FLOOR PLAN




***ENVIRONMENTAL RESPONSIBILITY THROUGH ENERGY EFFICIENCY***

# THE PEOPLE BEHIND THE ADVANCED HOUSE

The advanced house would not exist without the efforts of many individuals. Some put in incredible hours of volunteer time, and others exceeded the bounds of their organizations in order to make this project happen. These people include: Joel Allarie, Greg Allen, Anita Aiello, Collette Anthon, Conrad Belanger, Margi Billesdon, Jane Darragh, Peter del Fatti, Enrico di Nino, Dieter Heins, Pat Saya, Scott Stevens, Virginia Warwick, and Elizabeth White; and many others, all of whom share a commitment to the environment and a desire to demonstrate some solutions.

## INTERIOR DESIGN AND LANDSCAPING

The interior design was donated by the design companies Anna Patricia Design, Design Concepts, and Margael Designs. The landscaping around the Advanced House was sponsored by Landscape Ontario in association with the Ontario Association of Landscape Architects, Canadian Organic Growers, and the students of Humber College.

# PROJECT PARTICIPANTS

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ONTARIO HYDRO
Program Support & Service Division,
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INTERNATIONAL ENERGY AGENCY
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580 Booth Street, Ottawa, Ontario K1A 0E4

BRAMPTON HYDRO
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## BUILDER

FRAM BUILDING GROUP
220 Humberline Drive, Rexdale, Ontario M9W 5Y4
(416) 675-9179

## ASSOCIATIONS

CANADIAN HOME BUILDERS' ASSOCIATION
200 Elgin Street, Suite 502, Ottawa, Ontario K2P 1L5
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ONTARIO HOME BUILDERS' ASSOCIATION
20 Upjohn Road, North York, Ontario M3B 2V9
(416) 447-0077

ASSOCIATION OF REGISTERED INTERIOR DESIGNERS OF ONTARIO
168 Bedford Road, Toronto, Ontario M5R 2K9
(416) 921-3660

ONTARIO ASSOCIATION OF LANDSCAPE ARCHITECTS
170 The Donway West, Suite 120, Don Mills, Ontario M3C 2G3
(416) 443-1785

LANDSCAPE ONTARIO (and the students of Humber College)
1293 Matheson Blvd.,E., Mississauga, Ontario L4W 1R1
(416) 629-1184

SOLAR ENERGY SOCIETY OF CANADA
3-15 York, Ottawa, Ontario K1N 5S7
(613) 236-4594
CANADIAN ORGANIC GROWERS
PO Box 6408, Station J, Ottawa, Ontario K2A 3Y6
(416) 485-3534

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### *PROJECT MANAGER*

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49 Spadina Avenue, Suite 305, Toronto, Ontario M5V 2J1
(416) 599-0608

DESIGN CONCEPTS
345 Lakeshore Road East, Suite 214, Oakville, Ontario L5J 1J5
(416) 338-0800

MARGAEL DESIGNS INC.
2150 Dunwin Drive, Unit 3, Mississauga, Ontario L5L 5M8
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DIANE WATTS
160 Pears Avenue, Suite 203, Toronto, Ontario M5R 1T2
(416) 961-2887

DIANNE SHORE
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JANICE STARR & ASSOCIATES
81 Granton Drive, #2, Richmond Hill, Ontario L4B 2N5
(416) 886-0026

L'ATELIER EN VILLE
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